A CONCURRENT STUDY OF COMPLEMENT C_3 AND C_4 ACTIVITY IN MATERNAL AND NEONATAL SERUM

THESIS

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C E R T I F I C A T E

This is to certify that the work entitled "A CONCURRENT STUDY OF COMPLEMENT C_3 AND C_4 ACTIVITY IN MATERNAL AND NEONATAL SERUM", which is being submitted as Thesis for M.D.(Paediatrics) Examination 1995, Bundelkhand University, Jhansi, has been carried out by Dr. Hiru Navaney herself in this department.

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She has also fulfilled all the conditions necessary for the submission of thesis.

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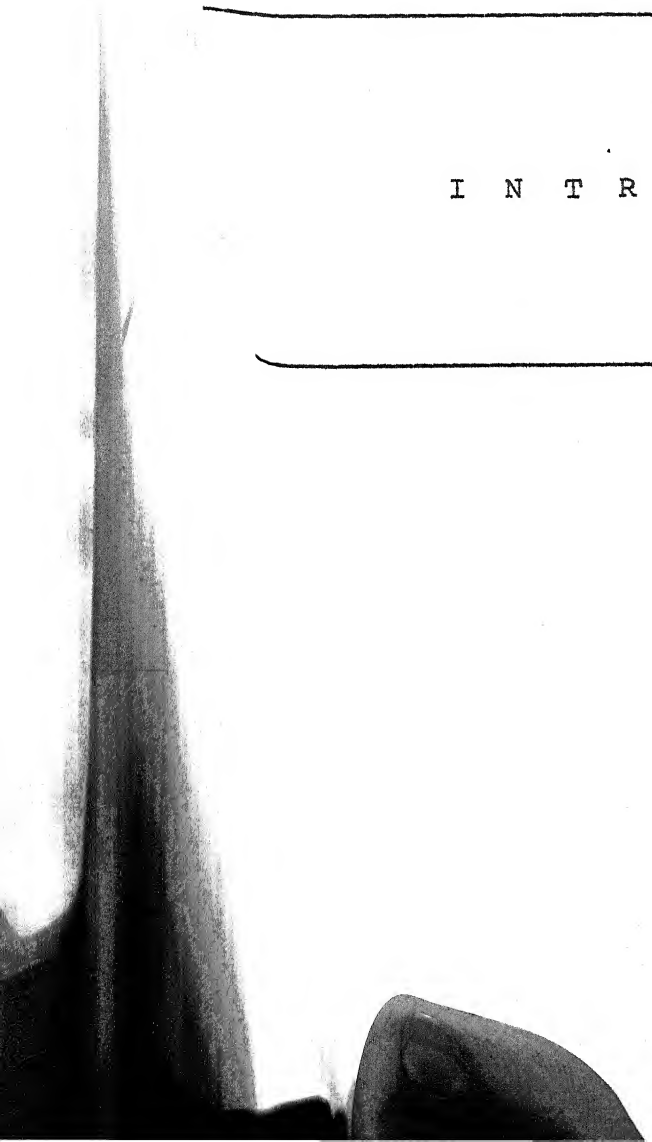
C O N T E N T S

I N T R O D U C T I O N



INTRODUCTION

Complement plays an integral role in host defense against infection. Evidence for this point of view comes from the observation that recurrent infection occurs in individuals born with deficiency of certain complement cascade and from careful analyses of complement function in vitro, showing that this system is required for many anti-microbial processes. The protective function of complement appears to be directed primarily against extracellular pathways namely the pyogenic and enteric bacteria, which are pathogenic because they resist phagocytosis. Antibody and complement through the process of opsonization overcome the resistance, with the possible exception of viruses (Mills and Cooper, 1978). Complement however does not play an important role in resistance of infection by intracellular parasites.

It is difficult to define complement system. Many deonote complement as an auxillary mechanism involved exclusively in activity of antibody or solely as an effector mechanism during inflammation.

Complement represents a biological system involved with the entire immune process and its major role may well be to modulate and regulate a large portion of that response.

The core of this system consists of atleast 12 separate and distinct serum proteins. In addition,

there are a number of other serum proteins which are critical to the activation and modulation of these basic components. It was reported by Spitzer (1977) that all the proteins under consideration exist in plasma in an inactive or active state. When complement activity is initiated these proteins interact in a sequential orderly fashion.

The activity of one protein is dependent on its predecessor and often determines the fate of next component in sequence. The term cascade has frequently been applied to these interactions which seem to be a useful designation.

Complement is activated through two major pathways. The classical pathways is initiated by antigen antibody interaction or by a complex of C-polysaccharide and C-reactive protein . Components in the sequence are designated as C-142356789 and the alternate pathway in the order of activator (Antibody) - properdin system - C-356789.

The result of activation of either pathway is the fixation of C_{3b} and thereby opsonization of invading bacteria. Activation of either pathway also results in the release of C_{3a} and C_{5a} which serve as major chemotactic factor, and the fixation of late acting components to the organism which induce their lysis.

The concentration of C_3, C_4 and C_5 are lower in newborns than in adults and the adult levels are achieved at 3-6 months of age (Fireman et al, 1969). Similarly Stosselet et al (1973), Feinstein and Kaplan (1975) and

Adamkin et al (1978) have reported defective opsonization and low level of C_3, C_5, properdin and component B in cord serum.

Ballow et al (1974) demonstrated deficiency of all nine complement components in cord sera relative to maternal serum. At 4th day of age, C_{1q}, C_1, C_2, C_4 and C_7 levels were increased markedly to maternal levels. C_3 was the only component which exhibited no significant change between birth and at 4th day of age. A marked deficiency of serum levels of C_8 and particularly of C_9 was evident at birth.

According to Johonston et al (1978) whole complement hemolytic activity also appears to be subnormal in approximately half of term infants with mean activity being about 70 to 90% of normal. Similarly they reported that the concentration of C_{1q}, C_4, C_2, C_3 and C_7 was 60% to 100% of adult concentration in term infants and somewhat less in preterm infants.

The fact that preterm and term infants are also deficient in CH_{50} and complement component during the first month of life raises the possibility that the neonates might have impaired complement dependent biological functions, which accounts for the impaired resistance to infection especially in preterm babies.

It is in the light of these observations that the present venture is directed to study the complement

cascade in both mothers and their babies and to assess the concentration of these complement components in relation to birth weight and gestational age.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

Newborn infants, especially low birth weight babies, have an unusually high incidence of severe bacterial infection. Further after infection ensues, the response to the infection in low birth weight babies differs from an older infant in that fever, leukocytosis and sedimentation rate elevation may be absent and the course may be one of rapid demise. To explain these lagging defenses, the immune status of these infants is suspect . The newborn synthesizes little immune globulins but recieves maternal IgG via the placenta. Since IgM and IgA do not cross the placenta, there is marked deficiency of these immunoglobulins at birth. In LBW infants there is, in addition, decreased placental passage of IgG, rendering these infants deficient in all three major immune globulins (Sawyer et al, 1971).

The immunological system is a segment of host defense that includes macrophages, leukocytes, lymphocytes and complement system. Together with physical barrier such as an intact integument and motile cilia, its primary function is to protect against invasion by infectious agents. The potential cost of this protection are allergy, autoimmunity and rejection of organ transplantation.

Mark Ballow and Milton Markowitz have classified immunological system in following way.

NONSPECIFIC (INNATE, NONADAPTIVE) HOST DEFENSES

Barriers

They act as front line in defense. There are two types :-

A. Anatomic (physical) barriers e.g. skin, cilia, mucus.

B. Biochemical barriers, e.g. lysozyme, lactoferrin, gastric acid.

Cells

These are involved in nonspecific defense, include leukocytes, mast cells, macrophages, cells of reticulo endothelial system, platelets and natural killer cells.

Plasma or Soluble Factor

They serve in conjunction with the cellular elements of nonspecific defense system and include proteins of Kenin-Kalikrein system acute phase proteins and fibro-nectin.

Factors Released from Cells

Factor of the nonspecific defense system include alpha and beta interferon, interleukins lysosomal enzymes and mediators of anaphylaxis.

SPECIFIC (ADAPTIVE) HOST DEFENSES

The specific host defense involved an adaptive (immunogenic) response to foreign materials, followed by specific recognition and long term memory of the molecule(antigen) that caused the initial immune response.

Humoral Immunity

It defends primarily against the extracellular phase of bacterial and viral infections :-

a. Cellular elements : consists of B lymphocytes and plasma cells.

b. Serum factor : include five classes of immunoglobulins (Antibodies) IgG, IgM, IgA, IgD and IgE.

Cellular Immunity

It defends against intracellular organism e.g. viruses, fungi, parasites, and provides immune surveillance against malignant cells and foreign tissues.

a. Cellular elements : consists of T lymphocytes and their subsets.

b. T cell - derived factor include lymphokines, interleukins, helper and suppressor factors and gamma interferon.

COMPLEMENT

Complement represents a biological system involved with the entire immune process and its major role may well be to modulate and regulate a large portion of that response (Spitzer, 1971).

The newborns synthesize little immunoglobulins, but receives maternal IgG, via the placenta. Since IgM and IgA immunoglobulins do not cross the placenta, there is marked deficiency of these immunoglobulins at birth. In LBW infants there is in addition, decreased placental

passage of IgG globulins, rendering these infants deficient in all three major immune globulins.

Yet this antibody deficiency state offers only a partial explanation for the newborn's sluggish defense system in as much as agammaglobulenic patients, despite lower antibody and gamma globulins, show a much vigorous response to infection. For this reason investigation of other components of immune system in newborn has been undertaken like complement system as stated by Sawyer et al, 1977).

COMPLEMENT PROFILE IN NEWBORN BABIES

Complement refers to protein component in human serum which are involved in inflammatory and immunological reaction.

HISTORY

The discovery of complement system is credited to Preiffer, which resulted from his studies conducted way back in 1894 on cholera infection produced experimentally to guinea pig. Pfeiffer observed that reinoculation of cholera bacilli intraperitoneally into guinea pig that had recovered from an earlier infection by the same bacteria, resulted in rapid dissolution of bacteria in the peritoneal cavity. He designated this effect as Pfeiffer phenomenon.

Further Pfeiffer noted that heated serum from immune animals was devoid of this bacterial property.

Bordet (1898) confirmed the Pfeiffer phenomenon. Ehrlich and Margnnath (1899) proposed the term complement for Alexin.

Four complements were discovered by the year 1920. C_3 fraction was first isolated from human serum by Miller-Eberhard Milen (1960). At present complement system is recognised to consist of at least 20 separate (14 complement components and 6 regulatory proteins), that circulate in blood as inactive precursors and molecules (Miller-Eberhard et al, 1976-77).

The complement system is composed of two parallel but independent pathways (the classic and alternative or properdin) that leads to activation of factors resulting in generation of various biological activities, such as phagocytosis and antibody dependent and independent cell lysis (Fig 1). Complement components have numbers in the classic pathway and letters in the alternative pathway. The third component C_3 is most abundant and is a pivotal factor linking both pathway. Once C_3 is activated, the remainder of components are activated in a standard cascade. The end point is lysis of target cells by a complex consisting of C_{5b}, C_6, C_7, C_8, C_9. The classical pathway may be activated by antigen antibody complexes (IgG, and IgM complexes) and non immunologically by C-reactive proteins and trypsin like enzyme. The alternate pathway may be activated by C_{3b} generated through classical complement activation and non-innumologically.

by lipopolysaccharides, fungal substances or by bacterial polysaccharide (Endotoxin) (T. Sher).

COMPLEMENT SYSTEM

Classical pathway

Antigen antibody complexes

1 molecule of IgM or 2 IgG

C_1 (C_{1q}, C_{1r}, C_{1s})

Activated C_1 + Ag Ab

C_4, C_2

Inactivation by C_1 esterase inhibition

Activated $C_{1,4,2}$ Ag Ab

Alternative pathway

Antibody independent

C_3

Factor B

C_{3b}

Factor D

Factor B clearing enzyme

C_{3b} (Convertase stabilized by properdin).

C_3 cleving activity - C_3 - C_{3a} Anaphylatoxin

Antibody dependent lysin C_{3b} + C_5

C_{3b} (opsonization)

C_{5b} + C_6, 7, 8, 9

Inactivation

C_8 binding protein

Membrane attack complex

Antibody independent lysin

Complement components are not immunoglobulins. Several of them are beta globulins.

Table I shows the various complements that are chemically, functionally and immunologically distinct as described by Turner (1983).

TABLE I : Properties of complement components.

Component	Serum concentration (ugm/ml)	Molecular weight	Substrate cleared
Classical pathway early components			
C_{1q}	150	410000	
C_{1r}	50	100000	C_{1s}
C_{1s}	50	93000	C_4, C_2
C_4	400	200000	
C_2	15	110000	C_3, C_5
C_3	1200	180000	
Alternative pathway early components			
D	5	24000	B
B	200	93000	C_3, C_5
P	25	204000	
C_3	1200	180000	
Terminal Components			
C_5	80	200000	
C_6	70	120000	
C_7	65	120000	
C_8	80	154000	
C_9	200	79000	
Central proteins (Regulatory proteins)			
C_1 inhibitor	200	110000	
C_4 binding protein			
C_{3b} inactivator(J)	20	100000	
B_{1-H} globulins (H)	650	150000	
Serum carboxy peptidase B & N inactivator of the anaphylatoxin C_{3a}, C_{4a} and C_{5a} properdine.	35	310000	

QUANTITATION OF COMPLEMENT SYSTEM

Immunodiffusion is an important precipitin test used for quantitative assessment of complement in the serum.

Qudin (1946) described a single diffusion single dimension precipitin test. In this technique antigen is allowed to diffuse through gel containing antibody placed in a convenient sized tube. A band of precipitates forms at the zone of equivalent concentration.

Elek and Ouchterlery (1948) published their double diffusion, double dimension technique. The authors described that when antigen and antibody were placed in separate wells cut in the gel at a suitable distance from each other and were allowed to diffuse, various type of precipitin lines were formed at zone of equivalance.

Oakley and Fulthrope (1953) devised a double diffusion single dimension system. In this method a zone of nutrient agar was placed between antigen and antiserum in a tube.

Feinberg (1957) first developed single diffusion double dimension technique. Radial immunodiffusion which was modified by Mancini (1963). Authors observed that antigen diffused radially from the point of application into a gel containing antibody and a circular precipitate was formed at zone of equivalance. The diameter of precipitin ring was proportional to the concentration, provided that gel thickness remained constant. Authors allowed antigen to diffuse until the precipitin ring stopped enlarging.

Single radial immunodiffusion method has been found to be simple, easily performed and in wide use especially due to its easy availability in the market (Mancini et al, 1963).

BIOLOGICAL IMPORTANCE OF COMPLEMENT

Biological activities of complement component in immunologic and inflammatory response are given in Table II (Turner et al, 1983).

TABLE II :

Complement	Activities
C_1	Stabilisation of antigen and antibody complexes.
C_{4b}	1. Nutralization of virus infectivity. 2. Immune adherence to lymphocyte and pagocyte cells.
C_{2b} derived	fragment : Kinin activity.
C_{3a}	Anaphylatoxins
C_{3b}	1. Opsonization - binds to specific receptor on neutrophils, eosinophils, macrophage. 2. Binds to B lymphocytes i.e. modulate immune response.
C_{3d}	Mediate immune adherence through binding to a specific receptor on macrophages.
C_{5a}	1. Anaphylatoxin. 2. Chemotactic factor.
$C_{5b, 6,7}$	Chemotactic factor.
C_8	Low grade membrane damage
C_9	Rapid membrane damage.

Frank et al (1985) observed that complement enhances the antibody activity in bacterial infection. The worker opined that biologically active byproduct of complement activation were assuming greater importance. In this regard the worker cited the example of C_{3a} and C_{5a} fragments released by enzymatic digestion of the respective precursor complement components, which release histamine from mast cells and are chemoattractant for polymorphonuclear leukocytes.

They commented upon the speculative role of these molecules and C_{3b} in immunoregulation of T and B cell function and induction of suppression.

Paul et al (1985) reviewed the subject and concluded that complement deficiency states were uncommon. However some of deficiencies were associated with characteristic clinical syndromes, allergic disorders, recurrent infection or certain rheumatic disease as opined by the authors.

Table III shows most common complement abnormalities detected in infectious diseases (Spitzer, 1977).

TABLE III : Common complement abnormalities detected in infectious diseases.

Condition	At diagnosis	To follow during therapy
Congenital	CH_{50}	NA
Component deficiency	Specific component deficiency	
Neonates	serum C_3, C_5 P Factor B	NA
Leinen's disease	Defective yeast phagocytosis	Yeast phagocytes
Hypercatabolism of C_3	serum C_3	NA
Congenital deficiency of C_{3b} INA	serum C_{3b} 1 NA, C_3 Factor B	C_3
Thermal injuries	serum C_3, defective chemotaxis, phagocytosis assay.	Phagocytosis
Malnutrition	serum C_3	C_3
Resulting from infection	Serum C_4, C_3	C_4, P
Immune complex formation	Properdin	
Endotoxemia	Serum C_3 factor B	C_3
Active hepatitis	Serum C_3 & C_4	C_3

SYNTHESIS, ONTOGENY AND GENETICS

C_{1q}, r & s seem to have independent synthetic sites, synthesis of macromolecule C_1, however, has been found in epithelial cells of gastrointestinal tract, macrophages apparently produce C_4 and C_2 while liver synthesizes C_3, C_5, C_6 and C_9 (and possibly C_2).

In man syntheses of complement can occur as early as eighth week of gestation and precedes the appearance of immunoglobulins. Numerous genetic deficiencies exist and genetic polymorphism is present for C_3 and factor B. Finally synthesis of various complement component have been linked to the H_2 gene in mice and HLA system in man (Spitzer, 1977).

Subnormal complement activity in cord serum was reported in 1927 by Larrier et al and several other early studies confirmed this finding.

In 1937, Solling demonstrated that cord blood CH_{50} was lower than that of paired maternal blood, an observation which was confirmed by Wasserman and Albert (1940) later. Traub (1943) also confirmed these observations and showed that post-partum maternal sera had higher complement levels than serum from normal control women and that no correlation existed between the complement levels in maternal and newborn sera.

The total haemolytic activity in normal full term newborn is approximately half of that found in mother (Arditi and Kigro, 1957; Fisher and Pearlman, 1961).

Using the "R" reagent, Fisher and Pearlman (1961) reported that C, C_1, C_2, C_3 haemolytic activities were 1.2 to 2.6 times greater in maternal than paired cord serum with an average of two fold difference.

Lundh et al (1966) reported that complement C_3 was present in neonates in a concentration of 1.2 mg/ml.

Similar findings were reported by Kohler and Muller-Eberhard (1967). They also reported that C_3 is the fraction of complement system present in largest amount in blood.

Kohler reported that mean cord level of CH_{50} C_{1q}, C_3, C_4 and C_5 in the serum of neonates were 0.601, 0.752, 0.562, 0.55 and 0.602 of maternal concentration respectively.

Propp and Alter (1968) have also reported that mean neonatal C_3 concentration was 88.8 mg% whereas mean maternal C_3 was 178.3 mg%.

The purpose of Fireman et al (1969) was to examine the development of human complement system by quantitation of total haemolytic complement activity and the individual complement component C_3, C_4, C_5 in serum from newborn infant and their mother at various length of gestation and also from infant during the 1st year of life.

They observed that concentration of the total C' (CH_{50}) activity and C_1 components, C_3, C_4, C_5 was greater in maternal sera than in sera of neonates. Mean standard deviation concentration, standard deviation and range of CH_{50}, C_3, C_4, C_5 in the sera of infants whose gestational age were 36-42 weeks and their mother are listed in table IV.

TABLE IV :

Complement	Maternal Mean ±SD	Maternal Range	Neonatal Mean ±S.D.	Neonatal Range	Maternal/ Neonatal Mean±S.D.
CH_{50} (Units)	51.3 ± 9.3	42.0-67.5	27.9 ±7.6	16-55	0.53±0.15
C_3 (mg%)	139.3 ±33.4	80.0-180.0	75.7 ±19.3	48-102	0.54±0.14
C_4 (mg%)	24.3 ± 7.9	17.0-46.5	15.8 ±3.8	10-24	0.56±1.6
C_5 (mg%)	11.9 ± 3.6	4.0-16.0	5.8 ±2.5	2.2-10.5	0.67±0.19

The difference between the mean maternal and mean neonatal CH_{50}, C_3, C_4 and C_5 concentration were highly significant ($p < 0.05$).

The result of this study demontrates that the sera of both term and preterm infants were deficient in total haemolytic activity (CH_{50}), C_3, C_4 and C_5 by maternal and normal adult standard. At the time of delivery the mean ratio of total haemolytic complement in the sera of normal term infant whose gestational age was 36 to 42 weeks to mean maternal levels was 0.53. The ratio of mean term neonatal serum concentration C_3, C_4 and C_5 to mean concentration of maternal serum were respectively 0.54, 0.56 and 0.61.

According to Adinolfi (1970) the mean values of CH_{50} in maternal sera was 49.2 (SD = 12.4) and that in cord sera 24.4 (SD = 9.3). The ratio between newborn and maternal mean values was 0.495.

In all instances the concentration of CH_{50} was lower in cord serum than in corresponding maternal sample.

The mean concentration of C_3 in full term newborn was 54.4 mg/100 ml while in maternal sera the mean level was 143.4 mg/100 ml. The mean maternal concentration of C_4 in full term newborn was 16.3 mg/100 ml whereas the mean maternal concentration of C_4 was 28.1 mg/100 ml.

The ratio between newborn and maternal level was 0.58.

Sawyer et al (1971) indicated that newborn infant with birth weight greater than 2500 gm have a functionally normal complement system, however, 50% of infants with birth weight less than 2500 gm have significant complement deficiencies. Table V shows a summary of mean levels and standard deviation of total haemolytic complement of newborn infants of various birth weight and paired maternal serum levels.

Table VI shows the comparison of the results of various studies of complements in serum from infants and their mothers. Whole complement and concentration of most complement have been 50-65% of mothers.

TABLE V : Complement component levels (Mean ± Standard error of mean).

Birth weight (gm)	Ratio of standard serum								
	CH_{50}	C_{1q}	C_2	C_3 (B1c)	C_4	C_4 (B1E)	C_{1q}	B_{1c}	B_{1E}
<1000	0.6±0.1 (7)	0.5±0.1 (7)	1.2±0.1	0.6±0.1 (7)	0.5±0.1 (7)	0.6±0.2 (7)	1.2±0.2	89±16	9±3
1000-1500	0.7±0.1 (7)	0.4±0.2 (3)	0.4±0.2 (3)	0.7±0.1 (9)	1.4±0.3 (7)	0.8±0.1 (9)	1.1±0.1	94±10	12±2
1500-2000	0.7±0.3 (5)	0.7±0.1 (8)	1.2±0.5 (4)	0.9±0.2 (7)	1.0±0.6 (4)	1.0±0.3 (8)	1.6±0.3	141±24	15±4
2000-2500	0.9±0.2 (5)	0.8±0.1 (5)	1.0±0.2 (5)	1.0±0.2 (5)	1.2±0.4 (5)	1.4±0.3 (5)	1.9±0.3	151±33	21±5
> 2500	0.9±0.1 (8)	0.9±0.5 (11)	1.0±0.2 (6)	1.0±0.1 (11)	1.4±0.2 (7)	1.0±0.1 (11)	2.2±0.1	160±13	16±2
Mothers	1.5±0.1 (24)	0.9±.04 (25)	1.2±0.2 (18)	1.8±0.1 (27)	1.9±0.2 (23)	2.3±0.1 (26)	2.3±0.1	254±12	35±2
Normal standard	1	1	1	1	1	1	2.5	145.2	15.2

TABLE VI : Activity of classical pathway and concentration of its complement in sera from newborn in comparison with maternal sera.

Complement	Kohler (1968) Term	Fireman et al (1969) Term	Adinlfi (1970) Term	Sawyer et al (1971) Term	Ballow et al (1974) Term
CH_{50} [a]	0.608[b]	0.53	0.50[b]	0.60[b]	-
C_1	-	-	-	-	0.60[b]
C_{1q}	0.75	-	-	0.96	0.62
C_4	0.55	0.56	0.58	0.44,0.74	0.50[b]
C_2	-	-	-	0.84[b]	0.61[b]
C_3	0.56	0.54	0.38	0.56	0.53[b]
C_5	0.60	0.61	-	[illegible]	0.50[b]
C_6	-	-	-	0.45[b]	-
C_7	-	-	-	0.62[b]	-
C_8	-	-	-	0.28[b]	-
C_9	-	-	-	0.10[b]	-
No studies	23	16-24	9-22	6-11	23-42

(a) CH_{50} - total haemolytic complement.
(b) -quantified by haemolytic (functional) assay.

TABLE VII :

Complement	Sawyer et al (1971)		Strunk et al (1978)		Dreward and Arroyave(1978)	
	Term	Preterm	Term	Preterm	Term	Preterm
CH_{50}	0.90	0.71	0.81	0.59	0.65	0.27
C_{1q}	0.90	0.58	-	-	0.62	0.42
C_4	1.00	0.91	0.80	0.59	-	-
C_2	1.00	0.96	-	-	-	-
C_3	1.00	0.78	0.60	0.52	0.71	0.38
No studies	6-11	14-29	20-30	16-24	-	-

Ballow et al (1974) also obtained serum from infants at 4 days of age. All component except C_3 increased in concentration as compared to maternal levels during the first days of life, but only C_1 and C_{1q} concentration became equivalent to those of mothers.

In man synthesis of complement can occur as early as eighth week of gestation and preceeds the appearance of immunoglobulins (Colton et al, 1974). Drew and Arroyave (1978) found a statistically significant correlation between increasing birth weight and gestational age and increasing serum concentration of total haemolytic complement C_{1q}, C_4 and C_3.

Jagadeesan and Reddy (1978) showed that CH_{50} value in babies of $\geq$2500 gm weight was 29.4 unit/ml, between 2250-2500 gm was 29.5 unit/ml, between 2000-2250 gm was 26.8 unit/ml and $\leq$2000 gm it was 25.58 unit/ml. In this study they showed that complement CH_{50} activity did not seem to be altered in the light for date infant. This observation is contrary to that reported by McCracken and co-workers (1971) who noted a significant relationship between serum complement and birth weight of infant.

Johnstson et al (1978) showed that whole complement activity appears to be subnormal in approximately half of term infant with mean activity being about 70 to 90% of normal concentration of C_{1q}, C_4 and C_3 and C_7 have been 60-100% of adult concentration in term infants and somewhat less in preterm infants. Younger gestational

age has been correlated with lower levels of total haemolytic activity of C_{1q}, C_4 and C_3.

Johnston et al (1978) expressed their views regarding the role of complement in host defense mechanism. Though complement plays an integral role in host defense against infection with possible exception of viruses (Mills and Cooper, 1978), complement does not appear to play an important role in resistance to infection by intracellular parasites. Whether the newborn infant is actually predisposed to infection because of complement deficiency remain to be proved.

Tandon et al (1984) conducted their study in fifty LBW babies. Both preterm and intrauterine growth retarded IUGR) and their mothers were studied and 10 term appropriate for gestational age (AGA) and their mothers served as control.

Table VIII shows the maternal and cord serum C_3 levels in relation to gestation and intrauterine growth state.

The data in table VIII show that the cord serum C_3 levels were significantly lower in preterm as compared to term AGA and IUGR babies. The C_3 levels were not significantly different between term AGA and term IUGR babies amongst themselves.

The median values of cord serum C_3 levels were 49.8, 34.5, and 41.4 mg/dl in term AGA, preterm and term IUGR babies respectively.

TABLE VIII : Maternal and cord serum C_3 levels in relation to gestation and intrauterine growth status. (No. of subjects = 60).

Variable	Term AGA	AGA	Pre term IUGR	Total	Term IUGR Percentile		
					< 3rd	3-10th	Total
Number of subjects	10	18	5	23	10	17	27
Gestation (weeks)	39.3±1.56 (29 - 35)	33.2±1.73 (31 - 35)	34.0±1.73 (29 - 35)	33.4±1.72 (37 - 41)	39.2±1.39 (37 - 41)	39.1±1.59 (37 - 41)	39.2±1.45 (37 - 41)
Birth weight (kg)	3.2±1.5 (3.00-3.50)	1.8±0.25 (1.30-2.45)	1.3±0.27 (0.35-1.60)	1.7±0.33 (0.85-2.15)	1.8±0.2 (1.50-2.20)	2.2±0.13 (1.90-2.20)	2.0±0.24 (1.50-2.25)
MATERNAL serum C_3	92.0±21.10 (70.0-139.4)	92.7±37.84 (40.0-140.7)	85.9±25.87 (46.9-112.4)	91.2±36.18 (40.0-140.7)	87.2±24.97 (51.0-132.5)	79.8±29.52 (34.5-140.7)	82.5±27.67 (34.5-140.7)
Cord serum C_3	51.5±14.94	33.3±10.03 (33.9-57.9)	35.2±8.40 (23.1-42.2)	33.8±11.18 (13.8-57.9)	45.7±15.04 (30.4-84.9)	48.7±22.02 (16.5-88.7)	47.5±19.75 (16.5-88.7)

Tandon et al (1984) clearly demonstrated that cord serum C_3 levels were significantly reduced in preterm babies as compared to term AGA and term IUGR babies. Amongst the preterm the cord serum C_3 levels were not significantly different in further subgroups of gestation, and there was almost one and half times increase in the cord serum C_3 levels in term as compared to preterm babies.

The low cord serum C_3 levels predisposes a neonate to increased risk of infection due to (i) lower opsonic activity (a) as low C_3 levels causes lesser enhancement of IgG and IgM activity and (b) deficient chemotactic activity. Thus preterm infants are more susceptible to infection when compared to like weight fullterm babies.

Singh (1986) studied thirty two neonates with clinical and bacteriological evidence of infection. Twenty four neonates served as control in their study. Blood samples were taken for complement estimation. The workers reported that the infected neonates showed breakdown product of complement C_3 and these breakdowns were detected in 34.4% of infected patients. However, breakdown product of C_3 were not detected in any of healthy controls. The workers concluded from the above study that complement breakdown product of C_3 can be utilized as a diagnostic tool in cases of neonatal infections.

MATERIAL AND METHODS

MATERIAL AND METHODS

This prospective study was conducted in the Department of Paediatrics, M.L.B. Medical College, Hospital, Jhansi in active collaboration with the department of Obstetrics and Gynaecology over a period of one year from August, 1993 to August, 1994. The cases included in the study were selected from the newborn and their mothers delivered in the department of Obstetrics and Gynaecology. All newborns babies were divided into three groups :-

1. Full term normal newborns.
2. Premature or preterm babies ⁄37 weeks of gestation.
3. Intrauterine growth retarded symmetrical IUGR babies or small for gestational age (SGA) babies.

SELECTION OF CASES

Cases were selected in different groups according to following criteria :-

1. Full Term Normal Newborns

Thirty full term normal newborns were selected for the present study. The criteria of selection of these cases was :

a. Weight above 2500 gm.
b. Gestational age ranging from 37 to 41 weeks.
c. Apgar score at the time of delivery varying from 7-10.
d. There was no history of infection, toxemia, diabetes, prolonged rupture of membranes in the mother during pregnancy and labour.

e. None of the newborn was suffering from any infection or congenital malformation.

Bloos samples were taken from the umbilical cord in all the cases at the time of birth.

2. Premature or Preterm Babies

Ten preterm babies were selected for the present study. The criteria for selection of these cases was :-

- All the premature babies had gestation age below 37 weeks.
- The gestational age was assessed by the date of last menstrual period, and by physical characteristic criteria of Robinson et al (1965).
- Premature babies were again classified into AGA (Babies weighing between 10th - 90th percentile for the period of gestation) and SGA (Babies weighing less than 10th percentile for the period of gestation).
- In the present study 8 babies were AGA and two were SGA as assessed by the intrauterine growth chart prepared at A.I.I.M.S., New Delhi (Meharban Singh,).

Bloos samples were obtained from the umbilical cord at birth in each and every case.

3. Intrauterine growth Retarded(IUGR) or Small for Gestational Age(SGA) Babies

Ten IUGR babies were selected for the present study. The criteria for selection of IUGR babies was :-

Those babies having weight less than 10th percentile for gestational age. All these babies were showing

feature of intrauterine malnutrition (Symmetrical IUGR) evidenced by features of decreased linearity, loss of subcutaneous fat, loose dry skin and sparse hair (Lubehencan et al, 1983; Naeye, 1966; Drillen, 1970 and Usher, 1970).

OBSTETRICAL HISTORY

A. Antenatal History

A detailed antenatal history was recorded in each and every case. History of TORCH infection/drug/irradiation was excluded in the 1st trimester of pregnancy. History pertaining to disease of respiratory, cardiac and others systems, history of APH, eclampsia, multiple pregnancy, history of ABO or Rh incompatibility, duration of leaking, colour and odour of amniotic fluid was recorded. Number of pervaginal examination and history of vaginal infection was also recorded.

All mothers with anaemia, oedema, hypertension, congestive cardiac failure, acute and chronic infection, prolonged rupture of membrane and metabolic disorder like diabetes was excluded.

B. NATAL HISTORY

The mode of delivery viz. normal, vaginal delivery, breech delivery, forcep or delivery conducted by caesarean section was recorded.

C. POSTNATAL HISTORY

APGAR score at 1 minute and 5 minutes was recorded in each and every case. Life threatening congenital anomalies were also recorded. Subsequently it was our endeavour to see that the vital functions which had been established at birth were maintained or not. Emphasis was given to elicit the history of jaundice, superficial and deep infection and feeding in each and every case.

EXAMINATION OF NEWBORNS

General and systemic examination of baby was recorded in each and every case. The gestational age was assessed by the physical criteria of Robinson et al(1965) as well as by date of last menstrual period. Anthropometric measurement viz. head circumference, weight, length was recorded in each and every case. A complete general and systemic examination was conducted. Special emphasis was given to observe colour, cry, activity, posture, sucking and other neonatal reflexes. Care was taken to assess for evidence of superficial and deep infection.

Babies with haemolytic disease of newborns, congenital anomalies, chromosomal abberation, birth asphyxia, and suspected intrauterine infection were also excluded.

COLLECTION OF SAMPLES

Blood sample for the present study was taken from the umbilical cord at the time of delivery. 5 ml sample of mothers' blood was also taken simultaneously by venepuncture. 5 ml blood was collected from each case in a plain vial and serum was separated by centrifugation and stored at -20°C for determination of complement. Simultaneously the mother's sample was also centrifuged and stored at -20°C for determination of complements.

METHODS

The following complement profile was done in each and every case.

1. Complement C_3 level.
2. Complement C_4 level.

Complement determinations were done by method of single radial diffusion technique of Mancini et al (1965). Solugen (R) SRID Ready to use complement C_3 and C_4 plates supplied by M/S Immunodiagnostic Pvt Ltd. were utilized. The blood sample of mother and baby was centrifuged, sera was separated immediately and kept in deep freezer at -20°C till the time of complement estimation.

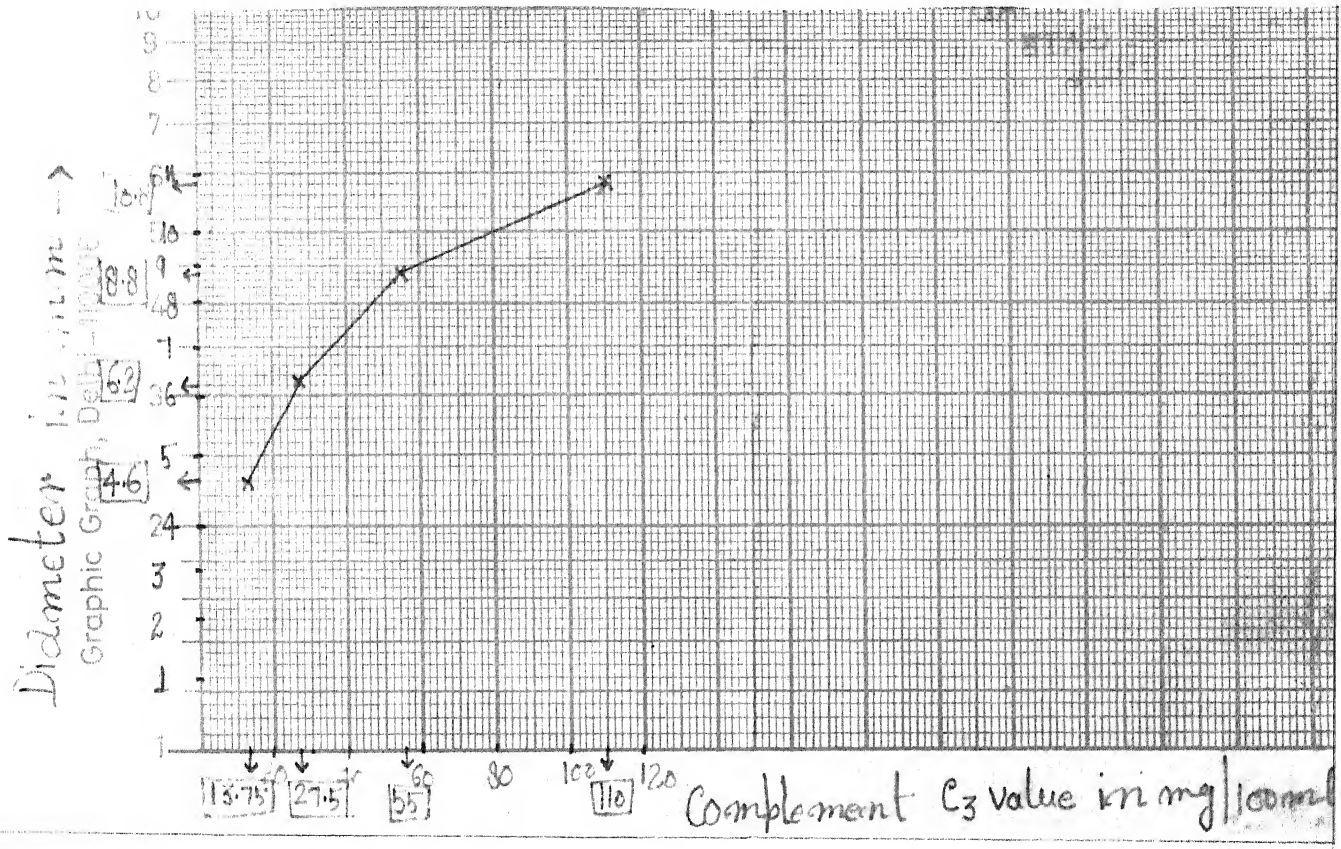
PROCEDURE

Each plate has 12 wells. In 4 wells 4 dilution of standard sera viz. 100%, 50%, 25% and 12.5% was taken.

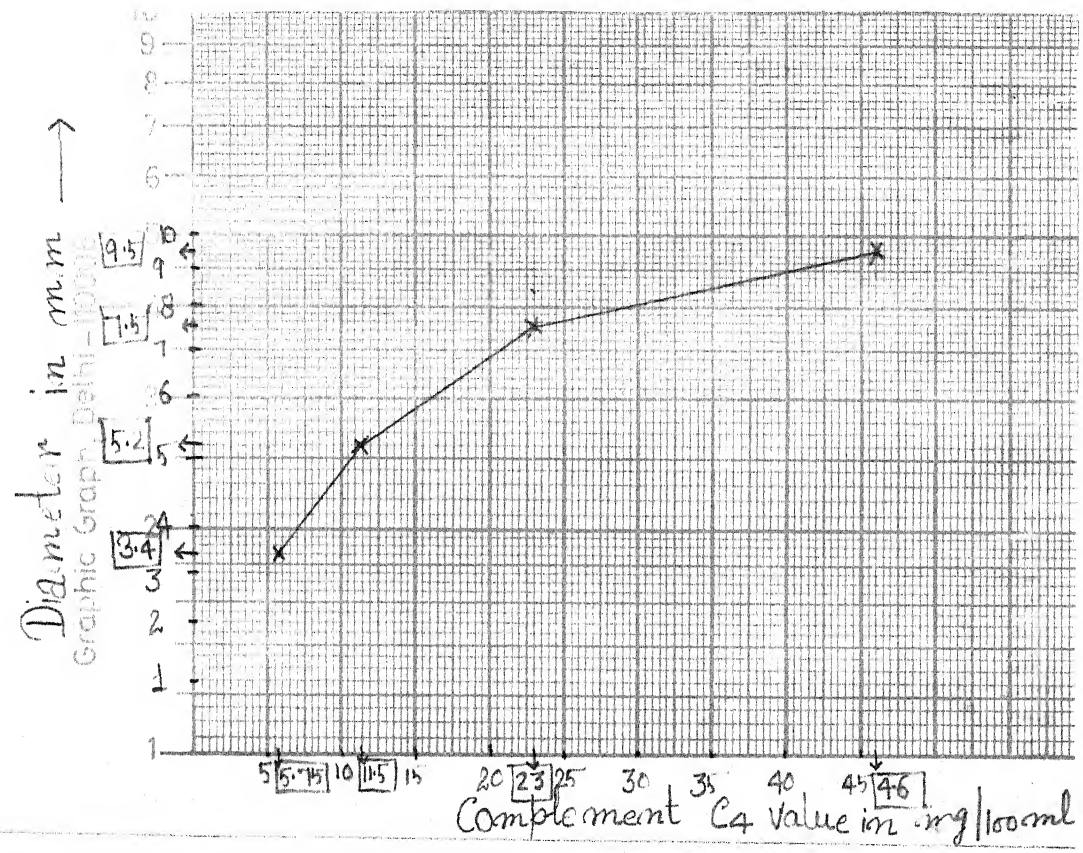
In the remaining wells serum sample was filled with the help of insulin syringe and No. 26 gauge hypodermic needle. The needle tip was rested on well bottom and the serum was slowly released drop by drop while the hole just seemed to disappear. Care was taken not to underfill or overfill the wells.

After filling the wells the lid of plate was replaced and plate was left for development of precipitation ring in inverted position for 24 hours at room temperature. The ring diameter was measured by an immunomeasure and standard graph for each complement was constructed using the values of reference standard. The diameter was plated on the ordinate while the quantitative value (Reference standard values) was plotted on the abscissa of the graph. Thereafter the values of the unknown samples were found out directly by interpolation and extrapolation on the standard graph. Results were expressed in mg/100 ml.

Graph between different dilutions of Reference Standard of Complement C_3 and Corresponding precipitation ring diameter.



Graph between different dilutions of Reference Standard of Complement C_4 and Corresponding precipitation rihg diameter.



O B S E R V A T I O N S

OBSERVATIONS

The present study was carried out in 50 neonates and their mothers delivered in M.L.B. Medical College, and allied Hospital, Jhansi over a period of one year.

The cases selected for present study were taken from various groups shown in Table I.

TABLE I : Showing various study groups.

Sl. No.	Study groups	No.of cases Baby	Mothers
1.	Full term normal newborns and their mothers.	30	30
2.	Premature or preterm babies and their mothers	10	10
	a. Appropriate for gestational age (AGA).	8	8
	b. Small for gestational age(SGA)	2	2
3.	Intrauterine growth retarded or small for gestational age babies and their mothers.	10	10

It is evident from Table I that of the total 50 newborns selected for the present study, 30 newborns were full term healthy babies, 10 were preterm babies, while another 10 babies constructed the small for date (symmetrical) IUGR babies. Among premature babies 8 were AGA (weighing between 10-90th percentile for their gestational age), while 2 were SGA (weighing less than 10th percentile for their gestational age).

TABLE II : Distribution of various study groups according to sex, gestational age and birth weight.

Sl. No.	Study group	No.of cases	Sex		Gestational age Mean±S.D. (weeks)	Birth weight Mean±S.D. (kgs)
			Male	Female		
1.	Full term normal newborns	30	20	10	39.38 ±0.92	2.55 ±0.14
2.	Preterm babies					
	AGA	8	5	3	32.50 ±2.29	1.70 ±0.17
	SGA	2	1	1	32.00 ±0.00	1.23 ±0.02
3.	IUGR	10	8	2	39.40 ±0.89	1.65 ±1.67

Table II shows the distribution of various study group according to sex, gestational age, and birth weight. It is evident from the table that males predominated in our study 34 (68%) as compared to females who numbered only 16(32%).

The mean gestational age of full term normal newborns was 39.38±0.92 weeks and their birth weight was 2.55±0.14 kg as depicted in table II.

In preterm group, babies who were AGA, had mean gestational age of 32.5±2.29 weeks and their mean birth weight was 1.7±0.17 kg. On the other hand babies who were SGA, had mean gestational age of 32±0 weeks while their mean birth weight was 1.23±0.02 kg.

The mean gestational age of IUGR babies was 39.4 ±0.89 weeks while their birth weight was 1.65±1.67 kg as illustrated in table II.

TABLE III : Serum complement C_3 profile in full term and preterm babies and their mothers.

Sl. No.	Study groups	No.of cases	Serum C_3 (mg/100 ml) Mean±S.D. (Range)	Groups compared (p value)
1.	Full term normal neonates (Group A)	30	44.4±6.0 (36.2-55) *49.1%	B Vs A ($\angle$0.01)
2.	Their mothers (Group B)	30	90.3±9.46 (86 - 108)	
3.	Premature babies (Group C)	10	31.3±1.97 (28 - 35) *32.2%	C Vs A ($\angle$0.05)
4.	Their mothers	10	97.3±5.89 (86 - 102)	
	a. AGA (Group E_1) babies	8	32.06±1.45 (30.5-35.0) *32.5%	E Vs A ($\angle$0.05)
	Their mothers (Group E_2)	8	96.0±6.18 (86-102)	
	b. SGA Babies(Group F_1)	2	28.5±0.71 (28 - 29) *28.2%	F Vs A ($\angle$0.05)
	Their mothers (Group F_2)	2	101±1.0 (100-102)	F Vs E ($\angle$0.05)

* = Neonatal/ma-ternal percentage.

Table III demonstrates the value of complement C_3 in premature babies and their mothers in comparison to the value observed in full term normal neonates and their mothers. It is evident from table III that in full term neonates mean serum C_3 value was 44.4±6.01 mg/100 ml, while C_3 value in mothers of full term neonates was 90.3± 9.46 mg/100 ml. Values between these two groups was found to be statistically highly significant (p $\angle$0.01).

Premature babies had lesser value of serum C_3 (31.3±1.97 mg/100 ml) as compared to full term normal

neonates (44.4±6.01 mg/dl). Values being statistically significant as determined by student 't' test ($p < 0.05$).

Premature babies with AGA had lesser value of serum C_3 viz. 32.66±1.45 mg/100 ml in comparison to its value in full term babies viz. 44.4±6.0 mg/100 ml. These values were statistically significant as determined by student 't' test ($p < 0.05$).

Premature babies with SGA had also lesser value of serum C_3 viz. 28.5±0.71 mg/100 ml in comparison to its value in full term babies viz. 44.4±6.0 mg/100 ml. Values between these two groups was found to be statistically significant ($p < 0.05$).

Among premature babies, SGA babies had lesser value of serum C_3 (28.5±0.71 mg/100 ml) as compared to premature babies with AGA (32.66±1.45 mg/100 ml). Values between the two were found to be statistically significant as determined by student 't' test ($p < 0.05$).

TABLE IV : Serum complement C_3 profile in full term and IUGR babies and their mothers.

Sl. No.	Study groups	No.of cases	Serum C_3 (mg/100 ml) Mean±S.D. (Range)	Groups compared (p value)
1.	Full term neonates (Group A)	30	44.4±6.01 (36.5-55) *49.1%	A Vs C (<0.05)
2.	Their mothers (Group B)	30	90.3±9.46 (86-108)	
3.	IUGR babies (Group C)	10	38.9±1.83 (36 - 42) *43.2%	
4.	Their mothers (Group D)	10	90.0±5.13 (84 - 102)	

* = Neonatal/meternal percentage.

Table IV demonstrates the value of C_3 in IUGR babies and their mothers in comparison to its value in full term neonates. It is evident from the table that IUGR babies had lesser values of C_3 (38.9±1.83 mg/100 ml) in comprison to the values observed in full term normal neonates (44.4±6.01 mg/100 ml). The difference in these values was found to be statistically significant as determined by student 't' test ($p < 0.05$).

TABLE V : Serum Complement C_3 profile in premature and IUGR babies and their mothers.

Sl. No.	Study groups	No.of cases	Serum C_3 (mg/100 ml) Mean±S.D. (Range)	Groups compared (p value)
1.	Premature babies (Group A)	10	31.3±1.97 (28- 35) *32.2%	A Vs E (<0.05)
2.	Their mothers (Group B)	10	97.3±5.89 (86 - 102)	
	a. AGA Babies(Group C_1)	8	32.06±1.45 (30.5-34) *32.3"	C_1 Vs E ($^1<0.05$)
	Their mothers (Group C_2)	8	96.0±6.18 (88 - 102)	
	b. SGA babies (Group D_1)	2	28.5±0.71 (28 - 29) *28.2%	D_1 Vs E ($^1<0.05$)
	Their mothers (Group D_2)	2	101.0±1.0 (100-102)	
3.	IUGR babies (Group E)	10	38.9±1.83 (36 - 42) *43.2%	B Vs F (<0.05)
4.	Their mothers (Group F)	10	90.0±5.13 (84 - 102)	

* Neonatal/maternal percentage.

Table V demonstrates the value of C_3 in premature babies and their mothers in comparison to the value in IUGR babies and their mothers. It is evident from the table V

that premature babies had lesser value of C_3 (31.3±1.97 mg/100 ml) in comparison to its values in IUGR babies (38.9±1.83 mg/100 ml). Difference between the two values was found to be statistically significant($p < 0.05$).

Premature babies with AGA had lesser values of C_3 (32.06±1.45 mg/100 ml) in comparison to its value in IUGR babies (38.9±1.83 mg/100 ml). Difference between the two was found to be statistically significant ($p < 0.05$).

Premature babies with SGA had also lesser value of C_3 (28.5±0.71 mg/100 ml) in comparison to that observed in IUGR babies (38.9±1.83 mg/100 ml). Values were statistically significant ($p < 0.05$).

TABLE VI : Serum complement C_3 profile in full term babies according to birth weight.

Sl. No.	Birth weight (gms)	No.of cases	Serum C_3 (mg/100 ml) Mean±S.D. (Range)	Groups compared (p value)
1.	1000 - 1500 (Group A)	2	35.0±1.0 (34 - 38)	A Vs B (<0.05)
				A Vs C (<0.05)
2.	1500- 2000 (Group B)	8	39.9±1.8 (36.5-42)	A Vs D (<0.05)
				B Vs C (<0.05)
3.	2000 - 2500 (Group C)	11	43.9±6.94 (36.2-54)	B Vs D (<0.05
4.	2500 - 3000 (Group D)	19	46.56±5.38 (36.4-55)	C Vs D (70.05)

Table VI demonstrates the serum C_3 level in different groups of birth weight in full term babies. Accordingly we divided our full term babies into 4 broad groupd viz. group A (babies weighing between 1000-1500 gms), group B (babies weighing between 1500-2000 gms), Group C (babies weighing between 2000-2500 gms) and group D(babies weighing between 2500-3000 gms). It is evident from the table VI that babies between birth weight 1000-1500 gms had significantly lower values of serum C_3 (35$\pm$1 mg/100 ml) in comparison to the values observed in the group of babies weighing between 1500-2000 gms, 2000-2500 gms and 2500-3000 gms where the values were 39.9$\pm$1.81, 43.9$\pm$6.94 and 46.56$\pm$ 5.38 mg/100 ml respectively. Thus a significant observation on dividing our casem material into different weight groups revealed that with increasing birth weight there was a corresponding rise of complement C_3 in each birth weight group. Values in each group being statistically significant ($p < 0.05$).

However full term babies weighing between 2000-2500 gms had lesser values (43.90$\pm$6.0 mg/100 ml) in comparison to the values in babies weighing between 2500-3000 gms (46.56$\pm$5.38 mg/100 ml). No statistical different value was found between these groups ($p > 0.05$).

Table VII demonstrates the serum C_3 levels in different groups of birth weight in preterm babies. A significant finding of our study as is evident from the Table VII was that babies weighing between 1500-2000 gms

had higher value of serum C_3 (32.06±1.45 mg/100 ml) in comparison to the C_3 values in babies weighing between 1000-1500 gms (28.5±0.71 mg/100 ml). The values were found to be statistically significant as determined by student 't' test ($p < 0.05$).

TABLE VII : Serum complement C_3 profile in premature babies according to birth weight.

Sl. No.	Birth weight (gms)	No.of cases	Serum C_3 (mg/100 ml) Mean±S.D. (Range)	Groups compared (p value)
1.	1000-1500 (Group A)	2	28.5±0.71 (28 - 29)	A Vs B (<0.05)
2.	1500-2000 (Group B)	8	32.06±1.45 (30.5-34.0)	

TABLE VIII : Serum Complement C_4 profile in full term and premature babies and their mothers.

Sl. No.	Study groups	No.of cases	Serum C_4 (mg/100 ml) Mean±S.D. (Range)	Groups compared (p value)
1.	Full term neonates (Group A)	30	14.78±2.79 (11 - 22) *50.1%	A Vs C (<0.05)
2.	Their mothers (Group B)	30	29.48±4.11 (22 - 42)	
3.	Premature babies (Group C)	10	9.8±1.67 (8 - 13) *39.7%	E_1 Vs A ($^1<0.05$
4.	Their mothers (Group D)	10	24.9±2.25 (22 - 29)	
	a. AGA babies (Group E_1)	8	9.9±1.76 (8 - 13) *39.1%	
	Their mothers (Group E_2)	8	25.3±2.29 (22 - 29)	
	b. SGA babies (Group F_1)	2	9.0±1.0 (8 - 10)	F_1 Vs A ($^1<0.05$)
	Their mothers	2	23.0±1.0	F_2 Vs E_2

Table VIII demonstrates serum C_4 level in premature babies in comparison to serum C_4 value in full term neonates and their mothers.

It is evident from the Table that premature babies had lesser value of serum C_4 (9.8±1.67 mg/100 ml) in comparison to the values observed in full term normal neonates (14.78±2.79 mg/100 ml). On statistical analysis the values in preterm babies was found to be statistically significantly less when compared to the values observed in full term babies ($p < 0.05$).

Premature babies with AGA had lower value of serum C_4 (9.9±1.76 mg/100 ml) in comparison to the value observed in full term neonates (14.78±2.79 mg/100 ml). Values between these two groups was found to be statistically significant.

Premature babies with SGA had also lower values of serum C_4 (9±1 mg/100 ml) in comparison to the value observed in full term neonates (14.78±2.79 mg/100 ml). Values between these two groups was found to be statistically significant.

Among premature babies, babies with AGA had slightly higher value of serum C_4 (9.9±1.76 mg/100 ml) than the values observed in SGA babies (9±1 mg/100 ml). However, no statistically significant difference was observed between these two groups ($p > 0.5$).

TABLE IX : Serum complement C_4 profile in full term and IUGR babies and their mothers.

Sl. No.	Study groups	No.of cases	Serum C_4 (mg/100 ml) Mean±S.D. (Range)	Groups compared (p value)
1.	Full term neonates (Group A)	30	14.78±2.79 (11 - 22) *50.1%	A Vs C ($\angle$0.05)
2.	Their mothers (Group B)	30	29.48±4.11 (22 - 42)	
3.	IUGR babies (Group C)	10	10.5±2.15 (9 - 15) *42.4%	
4.	Their mothers (Group D)	10	27.8±2.73 (22 - 32)	

* = Neonatal/meternal percentage.

Table IX demonstrates the serum C_4 level in IUGR babies and their mothers in comparison to its value in full term neonates and their mothers.

It is evident from the Table IX that IUGR babies had less value of serum C_4 in comparison to its value in full term normal neonates. Values of serum C_4 were 14.18±2.79 mg/100 ml and 10.5±2.15 mg/100 ml in full term neonates and IUGR babies respectively. Difference being statistically significant as determined by student 't' test (p $\angle$0.05).

TABLE X demonstrates the serum C_4 level in premature babies and their mothers in comparison to its value in IUGR babies and their mothers. It is evident from Table X that premature babies had lesser values of serum C_4 in comparison to the value in IUGR babies, though the values were not found to be statistically significant (p 70.5).

TABLE X : Serum C_4 profile in premature and IUGR babies and their mothers.[6]

Sl. No.	Study groups	No.of cases	Serum C_4 (mg/100 ml) Mean±S.D. (Range)	Groups compared (p value)
1.	Premature babies (Group A)	10	9.8±1.67 (8 - 13)	A Vs E (70.5)
			*39.7%	
2.	Their mothers (Group B)	10	24.9±2.25 (22 - 29)	
	a. AGA babies (Group C_1)	8	9.9±1.76 (8 - 13)	C_1 Vs E (^{1}70.5)
			*39.1%	
	Their mothers (Group C_2)	8	25.3±2.29 (22 - 29)	
	b. SGA babies (Group D_1)	2	9.0±1.0 (8 - 10)	D_1 Vs E (^{1}70.5)
			*39.1%	
	Their mothers (Group D_2)	2	23.0±1.0 (22 - 24)	
3.	IUGR babies (Group E)	10	10.5±2.50 (9 - 15)	
			*42.4%	
4.	Their mothers (Group F)	10	27.8±2.73 (22 - 32)	

* = Neonatal/maternal percentage.

Premature babies with AGA had slightly lesser value of serum C_4 (9.9±1.76 mg/100 ml) in comparison to its value in IUGR babies (10.5±2.15 mg/100 ml). Statistically no significant difference was observed between these two values (p 70.5).

Premature babies with SGA had also lesser values of serum C_4 in comparison to its value in IUGR babies. Serum C_4 value was 9±1 mg/100 ml and 10.5±2.15 mg/100 ml in premature babies with SGA and IUGR babies respectively. Statistically no significant difference was observed between two values (p 70.5).

TABLE XI : Serum complement C_4 profile in full term babies according to birth weight.

Sl. No.	Birth weight (gms)	No.of cases	Serum C_4 (mg/100 ml) Mean±S.D. (Range)	Groups compared: p value
1.	1000 - 1500 (Group A)	2	9.5±0.5 (9 - 10)	A Vs B : <0.05
2.	1500 - 2000 (Group B)	8	12.0±1.8 (9 - 15)	A Vs C : <0.05 A Vs D : <0.05
3.	2000 - 2500 (Group C)	11	14.54±2.18 (11 - 18)	B Vs C : >0.5 B Vs D : <0.05
4.	2500 - 3000 (Group D)	19	16.9±2.90 (11.5-22)	C Vs D : >0.5

Table XI shows the serum C_4 level in different groups of birth weight in full term babies. It is evident from the table that babies weighing between 1000-1500 gms had lesser value of serum C_4 in comparison to the value observed in babies weighing between 1500-2000 gms, 2000-2500 and 2500-3000 gms, values being 9.5±0.5, 12.0±1.8, 14.54±2.19 and 16.9±2.90 mg/100 ml respectively. A statistically significant difference was observed between all these groups ($p < 0.05$).

Babies weighing between 1500-2000 gms had lesser value of serum C_4 (12.0±1.8 mg/100 ml) in comparison to its value in babies weighing between 2000-2500 gms (14.54 ±2.18 mg/dl) and 2500-3000 gms (16.9±2.90 mg/100 ml). A statistically significant difference was observed between the values observed in babies weighing between 1500-2000 gms and 2500-3000 gms. However, no stiatistically

significant difference was observed in the values observed between babies weighing between 1500-2000 and 2000-2500 gms.

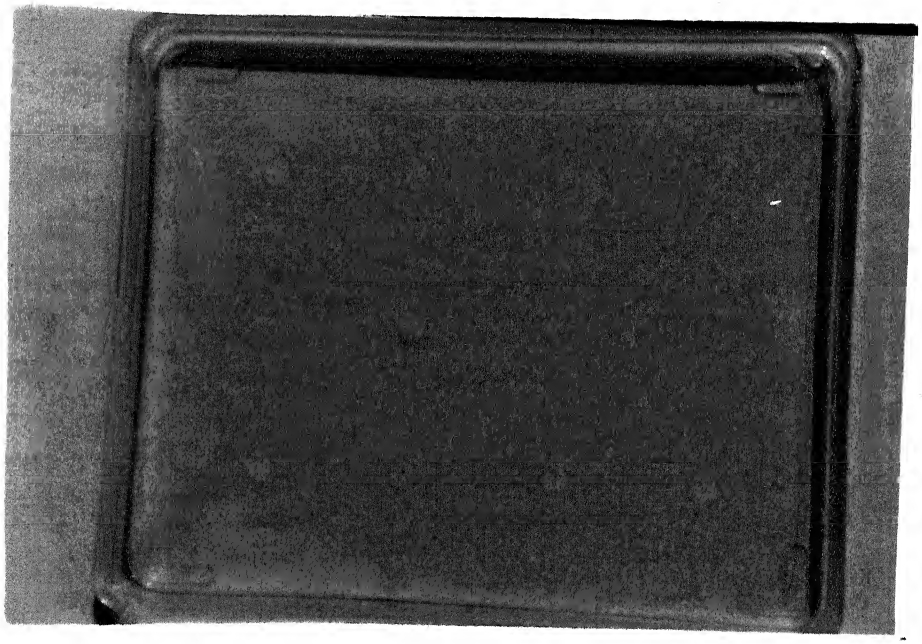
Babies weighing between 2000-2500 gms had lesser value of serum C_4 (14.54±2.18 mg/100 ml) in comparison to its value in babies weighing between 2500-3000 gms(16.9± 2.9 mg/100 ml). However, no statistically significant difference was observed between these groups.

TABLE XII : Serum C_4 profile in premature babies according to their birth weight.

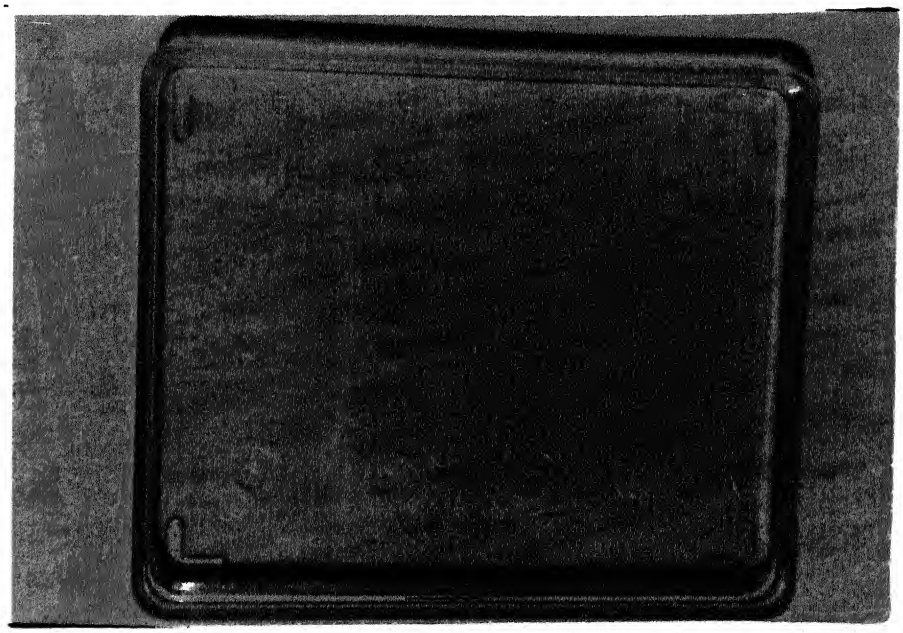
Sl. No.	Birth weight (gms)	No.of cases	Serum C_4 (mg/100 ml) Mean±S.D. (Range)	Groups compared (p value)
1.	1000 - 1500 (Group A)	2	9.0±1.0 (8 - 10)	A Vs B (>0.5)
2.	1500 - 2000 (Group B)	8	9.9±1.76 (8 - 13)	

Table XII demonstrates the serum C_4 level in different groups of birth weight in preterm babies. It is evident from table XII that babies weighing between 1500-2000 gms had higher values of serum C_4 (9.9±1.76) mg/dl) in comparison to its values in babies weighing between 1000-1500 gms (9±1 mg/100 ml). Difference was not statistically significant as determined by student 't' test (p >0.5).

Photograph : Showing precipitation ring of complement C_3.



Photograph: showing precipitation ring of complement C_4.



DISCUSSION

The present study was carried out to study the complement profile in 50 newborn babies and their mothers, delivered at M.L.B. Medical College and allied Hospital, Jhansi over a period of one year. The primary aim of our study was to evaluate the complement profile in full term normal healthy babies, preterm babies and babies suffering from intrauterine malnutrition(IUGR).

Besides evaluating the complement activity thorough physical examination was done in each and every case to categorise the newborn in our study groups.

Since the weight of baby has a direct impact on the complement profile, care was taken to weigh them carefully. The gestational age was assessed by the morphological characteristics and tallied with the history of last menstrual period as given by mothers.

Complement estimation was done by the method of single radial immunodiffusion technique of Mancini et al (1965).

Based on observations depicted in the Table I to XII, various inferences have been drawn and discussed in details herewith.

As shown in Table I, our study group comprised of 30 full term normal newborns and their mothers, 10 premature babies and their mothers and 10 intrauterine growth retarded babies and their mothers. Among premature

babies in our study 8 babies were AGA (babies weighing between 10-90th percentile for the period of gestation) while 2 were SGA (babies weighing less than 10th percentile for the period of gestation), as assessed by the intrauterine growth chart prepared at AIIMS, New Delhi. All the 10 IUGR babies were symmetrical IUGR showing features of intrauterine malnutrition evidenced by features of decreased linearity, loss of subcutaneous, fat, loose dry skin and sparse hair (Lubchencar et al, 1963; Kaeye, 1966, Drillen, 1970 and Usher, 1970).

Fireman et al (1969) in their study took 24 normal human full term newborns and their mothers and 15 premature neonates and their mothers. Adinolfi (1970) took 22 normal full term newborns and their mothers at the time of delivery. Shapiro et al (1981) studied 28 term newborn infants, of whom 17 were SGA and 11 AGA. Tandon et al (1984) studied 60 newborns and mothers, of whom 10 were term healthy AGA. Out of 50 LBW babies, 23 were preterms (gestation $<$37 weeks) and 27 were term IUGR babies i.e. weight below 10thn percentile for the gestation. Out of 23 preterm 18 were AGA and 5 were IUGR babies.

As depicted in Table II, of the total 50 newborn babies selected for the present study there were 34 males(68%) while the rest 16(32%) were females.

The mean gestational age of full term newborns was 39.38$\pm$0.92 weeks and birth weight was 2.66$\pm$0.14 kg. In preterm group, babies who were AGA had mean gestational

age of 32.5±2.29 weeks and their mean birth weight was 1.7±0.17 kg. On the other hand SGA babies had mean gestational age of 32±0 weeks, while their mean birth weight was 1.23±0.02 kg.

The mean gestational age of IUGR babies was 39.4±0.89 weeks while their mean birth weight was 1.65± 1.67 kg.

As has already been mentioned, the complement profile was assessed by the single radial immunodiffusion of Mancini et al (1965). It was observed (Table III) that the C_3 level in full term normal newborns was 44.4±6.0 mg/dl. Tandon et al (1984) reported a nearly similar value 49.8± mg/100 ml as reported by us. However, Propp and Alter (1968), Fireman et al (1969) and Adinolfi (1970) reported higher value of C_3 in their control group of cases (88.8, 75.7±19.3 and 54.4 mg/dl respectively).

Serum C_3 values in the mothers of full term neonates was 90.3±9.46 mg/100 ml. Tandon et al (1984) reported a nearly similar value of 92±21.10 mg/dl as reported by us. However, Propp and Alter (1968), Fireman et al (1969) and Adinolfi (1970) reported higher maternal values of C_3 in their studies as 178.3, 139.3±35.4, and 143.4 mg/dl respectively. It is evident from these observations that the concentration of C_3 in newborns was 49.1% (44.4±6.0 mg/dl) of that in mothers (90.3±9 mg/100 ml), signifying time proven fact that complement is not passively transferred from the mother but is

synthesized in the fetus. Fisher and Pearlman (1961), Kohler (1967), Propp and Alter (1968) Fireman et al(1969) and Adinolfi (1970) and Tandon et al (1984) had also observed decreased neonatal C_3 value in comparison to its value in maternal sera. The increase in maternal C_3 concentration in these studies, took being double when compared to their neonatal values.

Various hypotheses have been put forward from time to time for the lower C_3 levels in newborns, which approximates the maternal level by 6 month of age. Tandon et al (1984) attributed the decreased level to (a) decreased hepatic protein synthesis (b) Absence of transplacental transfer and (c) Presence of an anti-complementary substance in cord blood.

As shown in table III premature babies had lesser value of serum C_3 (31.3 ± 1.97 mg/100 ml) in comparison to its value in full term neonates (44.4 ± 6.0 mg/dl), the difference between these values was found to be statistically significant ($p < 0.05$). Tandon et al(1984) also observed significantly lower value of serum C_3 in preterm babies (33.8 ± 11.18 mg/dl) in comparison to the values in full term (51.5 ± 14.94 mg/dl) ($p < 0.05$).

Among premature babies a significant finding observed was that premature SGA babies had lower values of serum C_3 (28.5 ± 0.71 mg/dl) in comparison to its value in premature AGA babies (32.06 ± 1.45 mg/dl). The difference between these values was found to be statistically significant as determined by student 't' test ($p < 0.05$).

No other worker in the past had divided these preterm babies into AGA and SGA hence a comparison of our values to that of other worker could not be ascertained.

Kaur et al (1979) has opined that complement plays a role in the heat labile opsonic system and enhances phagocytosis of organism, a depression of this factor of immune response predisposes the premature baby to greater infection.

It was observed that premature babies had 32.2% (33.8±1.97 mg/dl) of serum complement C_3 in comparison to its value in mothers (97.3±5.89 mg/100 ml).

Table IV depicts the values of complement C_3 in IUGR babies when compared to that in full term babies. It was seen that IUGR babies had lesser values of C_3 (38.9± 1.89 mg/100 ml) in comparison to the value observed in full term normal neonates (44.4±6.01 mg/dl). The difference in these values was found to be statistically significant as determined by student 't' test ($p < 0.05$).

Shapiro et al (1981) observed lower value of serum C_3 in term SGA babies (75±15 mg/dl) in comparison to its value in AGA babies (90±18 mg/dl). Difference in these values was found to be statistically significant ($p < 0.02$). Tandon et al (1984) also reported lower value of serum C_3 in IUGR babies (47.5±19.75 mg/dl) in comparison to that observed in full term neonates (51.5±14.94 mg/dl), however, the difference was not found to be significant.

It is evident from table IV that IUGR babies had 43.2% of serum complement C_3 (38.9±1.83 mg/dl) in comparison to its value in mothers (90±5.13 mg/dl).

We also tried to observe a comparison between complement level in premature and IUGR babies as

depicted in Table V. A significant finding of our study was that premature babies, especially preterm SGA babies had the least values of C_3 when compared to the values in term and IUGR babies. Premature babies with AGA had lesser value (32.06±1.45 mg/100 ml) in comparison to its value observed in IUGR babies (38.9±1.83 mg/100 ml). Difference between the two values was found to be statistically significant ($p < 0.05$).

Premature babies with SGA had also lesser values of C_3 (28.5±0.71 mg/100 ml) in comparison to its value observed in IUGR babies (38.9±1.83 mg/100 ml). Values being statistically significant ($p < 0.05$).

Tandon et al (1984) like us had also observed significantly ($p < 0.05$) lower value of C_3 in premature babies (33.8±11.8 mg/100 ml) in comparison to the values observed in IUGR babies (47.5±19.75 mg/100 ml).

An attempt was also made to observe a correlation of the complement C_3 level according to the birth weight group in both preterm and term babies irrespective of their gestational age. According to it our babies were divided into various birth weight groups viz. 1000-1500, 1500-2000, 2000-2500 and 2500-3000 gm as depicted in Tables VI and VII.

Among term neonates, babies weighing between 1000-1500 gm had lesser values of serum C_3 (35±1 mg/dl) in comparison to the values observed in babies weighing between 1500-2000, 2000-2500 and 2500-3000 gms, values

being 39.9±1.81, 43.90±6.94 and 46.56±5.38 mg/100 ml respectively, the difference in the values was found to be statistically significant ($p < 0.05$) in all the groups.

Babies weighing between 1500-2000 gms had lesser values of C_3 (39.9±1.8 mg/100 ml) in comparison to its value in babies weighing between 2000-2500 and 2500-3000 gms values being 43.90±6.94 and 46.56±5.38 mg/100 ml respectively. Statistically significant difference was observed between these groups ($p < 0.05$). Babies weighing between 2000-2500 gm had lesser value of C_3 (43.90±6.94 mg/100 ml). in comparison to its value in the group 2500-3000 gms (46.56±5.38 mg/100 ml). However, no statistically significant difference was observed between these values ($p > 0.5$).

Among premature babies, babies weighing between 1000-1500 gms had lesser value of serum C_3 (28.5±0.71 mg/100 ml) in comparison to the value in babies weighing between 1500-2000 gms, who had serum C_3 value (32.66± 1.45 mg/100 ml). Difference in these values was found to be statistically significant as determined by student 't' test ($p < 0.05$). Thus, a significant finding of our study was that babies with the least birth weight(1000-1500 gms) had the lowest values of complement C_3 making them more prone to infections as compared to their counterpart who weighed more.

Sawyer et al (1977) in their study indicated that newborn infants with birth weight greater than 2500 gms have a functionally normal complement system, while 50% of infants with birth weights less than 2500 gms have significant complement deficiencies. He further stated that the significant difference in complement level in infant with birth weight above and below 2500gms, suggested either accelerated synthesis or placental transport in the late weeks of gestation.

Four arguments have been marshalled against the possibility of placental transport. Firstly, no correlation was found to exist between maternal and fetal complement proteins as observed by Traub (1943), Kohler (1968) and Sawyer et al (1971). Secondly there is no consistent or rapid decrease of C - protein levels in the first days of life as would be expected if neonatal levels were derived transplacentally. Fireman et al (1969) reported a rise rather than a fall of C_3, C_4 and C_5 in the first 45 days of life and Gitlin et al (1969) reported a stability of C_3 levels in the first 15 days of life. Thirdly there are allotypic difference (as detected by starch gel electrophoresis) of C_3 between mother and newborn sera indicating that synthesis of a different allotype of C_3 is occurring within the fetus and that little or no maternal C_3 crosses the placenta. Fourthly Gitlin et al (1969) have shown that cells from human embryos of 29 days gestation are capable of

synthetizing C_3. Thus this evidence strongly support the notion that complement proteins are synthesized by the fetus and do not cross the placenta.

Drew and Arroyave (1978) found a statistically significant correlation between increasing birth weight or gestational age and increasing serum concentration of total haemolytic activity C_{1q}, C_4 and C_3.

Tandon et al (1984) also observed increasing level of serum C_3 with increasing birth weight in both preterm and term babies. According to them preterm babies weighing $\leq$1500 gms had serum C_3 value of 38.85$\pm$ 11.89 gms while babies weighing between 2000-2500 gms had serum C_3 value of 40.50$\pm$15.90 mg/dl, on the other hand full term babies weighing $\leq$1500 mg/dl had serum C_3 value of 46.0$\pm$5.65 mg/dl while babies weighing $\geq$2500 gms had serum C_3 value of 51.5$\pm$14.94 mg/dl.

As depicted in Table VIII, serum C_4 values in full term neonates was 14.78$\pm$2.79 mg/100 ml. Fireman et al (1969) and Adinolfi (1970) have also reported nearly similar value of C_4 (15.8$\pm$3.8 mg/dl and 16.3 mg/dl) respectively as reported by us.

Serum C_4 values, in the mothers of full term neonates was 29.48$\pm$4.11 mg/dl. Fireman et al (1969) and Adinolfi (1970) have also reported nearly similar value of C_4 in the mothers (29.3$\pm$7.9 and 28.1 mg/dl) respectively as reported by us. It was seen that the mothers of full term neonates had higher value of C_4 (29.48$\pm$4.11

mg/100ml) in comparison to the values observed in neonates (14.78±2.77 mg/100 ml)..

It is evident from table VIII that C_4 levels in full term babies was 50.1% in comparison to its level in mothers.

On comparison of C_4 levels in term and preterm babies it was observed (Table VIII) that the premature babies had lesser values of C_4 (9.8±1.67 mg/100 ml) in comparison to the values observed in full term neonates (14.78±2.79 mg/100 ml) ($p < 0.05$). Among premature babies, babies with SGA had lesser value of C_4 (9±1 mg/100 ml) in comparison to its value in premature babies with AGA (9.9±1.76 mg/100 ml). However, no statistically significant difference was observed between these two values.

Since no worker in the past has divided the preterm babies into AGA and SGA hence a comparison of our values to that of other worker could not be ascertained.

It is evident from table VIII that concentration of C_4 in premature babies was 39.7% (9.8±1.67 mg/100 ml) of that in mothers (24.9±2.25 mg/100 ml).

As depicted in table IX, IUGR babies had lesser value of serum C_4 (10.5±2.15 mg/100 ml) in comparison to its value in full term neonates (14.78±2.79 mg/100 ml), difference in these two values was found to be statistically significant ($p < 0.05$).

Shapiro et al (1981) also observed lower though statistically insignificant values of C_4 in term neonates

SGA (20±10 mg/100 ml) in comparison to the values in their AGA babies (25±10 mg/100 ml).

As depicted in Table X, premature babies had lesser value of serum C_4 (9.8±1.67 mg/100 ml) in comparison to the values observed in IUGR babies (10.5±2.15 mg/100 ml) though the values were not found to be statistically significant ($p > 0.5$).

Attempt was also made to compare the values of C_4 in both groups of preterm babies to the values observed in IUGR babies (Table X). A significant finding of our study, unlike C_3 values was, that though the preterm babies demonstrated least values of complement C_4 when compared to that observed in IUGR babies. The values were not statistically significant ($p > 0.5$).

It is evident from Table IX that concentration of serum C_4 in IUGR babies was 42.4% (10.5±2.15 mg/100 ml) in comparison to its value in their mothers (27.8±2.73 mg/100 ml).

An attempt was also made to observe a correlation of the complement C_4 level according to birth weight groups in both term and preterm babies irrespective of their gestational age. Accordingly, our babies were divided into various birth weight groups viz. 1000-1500, 1500-2000, 2000-2500 and 2500-3000 gms and a linear correlation was found that babies having lesser birth weight had lesser values of serum C_3.

As depicted in Table XI and XII, babies weighing between 1000-1500 gms had least values of serum C_4 (9.5±0.50 mg/100 ml) on the other hand babies weighing between 2500-3000 gms had maximum value of serum C_4 (14.25±1.6 mg/dl).

Among preterm babies, babies weighing between 1500-2000 gms had higher value of serum C_4 (9.9±1.76 mg/100 ml) in comparison to the values observed in babies weighing between 1000-1500 gms (9±1 mg/100 ml). However, the values between thest two groups were not found to be statistically significant (p >0.5).

SUMMARY AND CONCLUSION

SUMMARY AND CONCLUSION

The present work has been carried out in the department of Paediatrics, M.L.B. Medical College and Allied Hospital, Jhansi with active collaboration of departments of Obstetrics and Gynaecology. Fifty newborns and their mothers belonging to various clinical groups were subjected to complement profile studies for the purpose of the present study. Out of these, 30 were full term normal neonates and their mothers, 10 were premature and their mothers and 10 were intrauterine growth retarded (symmetrical) neonates and their mothers. Among 10 premature babies, 8 were appropriate for gestational age (AGA) and remaining 2 were small for gestational age (SGA). All the cases were selected only after satisfying the selction criteria for each study group. A detailed history and physical examination of the mother was done along with special stress over the antenatal and natal factors. All the newborns and their mothers were subjected to various complement profile test for assessment of complement according to the method given by Mancini et al (1965).

Brief account of work conducted in the present study is being summarised here :

GROUP I : FULLTERM NORMAL NEWBORNS AND THEIR MOTHERS

Thirty full term normal newborns and their mothers constituted this group for the present study. Following are the values of complement C_3 & C_4 obtained in present study.

Serum Complement C_3 Level

The mean serum complement C_3 in the cord blood of full term newborns was 44.4±6.0 mg/100 ml with a range of 36.2 - 55 mg/100 ml.

The mean serum complement C_3 in blood of mothers of full term newborns was 90.3±9.46 mg/100 ml with a range of 86-108 mg/100 ml. It is evident from these observations that the concentration of C_3 in newborns was 49.1% (44.4±6.0 mg/100 ml) of that in mothers (90.3±9 mg/100 ml), signifying the time proven fact that complement is not passively transferred from the mothers but is synthesized in the fetus.

Serum Complement C_4 Levels

The mean serum complement C_4 in the cord blood of full term newborns was 14.78±2.79 mg/100 ml with a range of 11-22 mg/100 ml. The mean serum complement C_4 in blood of mothers of full term normal newborns was 29.48±4.11 mg/100 ml with a range of 22-42 mg/100 ml.

It is evident that C_4 level in term babies was 50.1% when compared to their mothers.

GROUP II : PREMATURE BABIES AND THEIR MOTHERS

Ten premature babies and their mothers were selected for present study. Among 10 premature babies 8 were AGA while remaining 2 were SGA. The values of serum C_3 and C_4 observed in present study are as below :.

Serum Complement C_3 Level

The mean serum complement C_3 level in premature babies was 31.3±1.97 mg/100 ml with a range of 28-35 mg/100ml.

The mean serum complement C_3 level in mothers of premature babies was 97.3±5.89 mg/100 ml with a range of 86-102 mg/100 ml. It is evident that the premature babies had 32.2% of serum complement C_3 level when compared to the values observed in mothers.

Our observations reveal that premature babies had lesser value of serum C_3 (33.3±1.97 mg/100 ml) in comparison to the values in full term normal neonates (44.4±6.01 mg/100 ml), values being statistically significant as determined by student 't' test ($p < 0.05$).

Among the premature babies a significant finding observed was that premature small for gestational age babies had lower values of serum C_3 (28.5±0.71 mg/100 ml) when compared to the values observed in premature appropriate for gestational age babies (32.86±1.45 mg/100 ml).

The decrease being more pronounced in preterm babies having intrauterine malnutrition. Various hypothesis have been put forward from time to time for the lower C_3 levels in newborns, which approximates the maternal level by 6 months of age. Tandon et al (1984) attributed the decrease level to (a) decrease hepatic protein synthesis, (b) absence of transplacental transfer and (c) presence of an anticomplimentary substance in cord blood.

Thus it is evident from present study that preterm babies had significantly decreased concentration of complement C_3 as compared to full term babies.

Serum Complement C_4 Level

The mean serum complement C_4 level in cord blood of premature babies was 9.8±1.67 mg/100 ml with a range of 8-13 mg/100 ml.

The mean serum complement C_4 levels in mothers of premature babies was 24.9±2.25 mg/100 ml with a range of 22-29 mg/100 ml.

It was observed that the premature babies had 39.7% of serum complement C_4 when compared to values observed in their mothers.

Premature babies had lesser value of serum complement C_4 (9.8±1.67 mg/100 ml) in comparison to that of full term babies (14.78±2.79 mg/100 ml), values were found to be statistically significant ($p < 0.05$).

As with C_3 levels among premature babies a significant finding observed was that premature SGA had lower value of complement C_4 (9±1 mg/100 ml) in comparison to the value observed in premature AGA babies (9.9±1.76 mg/100 ml).

Both these groups had lesser values of serum C_4 in comparison to that of full term neonates.

The depression of complement C_4 in preterm babies has been attributed in the literature to the same hypothesis as has been hypothesized for C_3 by various

authors.

Thus in nutshell our observations on the complement profile of preterm babies reveal a depression of both C_3 and C_4 activity which is one of the factor accounting for the increased incidence of infection observed in these infants.

GROUP III : INTRAUTERINE GROWTH RETARDED BABIES AND THEIR MOTHERS.

Ten intrauterine growth retarded babies (symmetrical IUGR) and their mothers were included in this group. Details of the values of complement C_3 and C_4 are given below :

Serum Complement C_3 Levels

The mean serum C_3 in cord blood of IUGR babies was 38.9 ± 1.83 mg/100 ml with a range of 36-42 mg/100 ml.

The mean serum C_3 in the mothers of IUGR babies was 90 ± 5.13 mg/100 ml with a range of 84-102 mg/100 ml.

It is thus evident that IUGR babies had 43.2% of complement C_3 in comparison to that of mothers.

A comparison of the C_3 values in the IUGR group, to the values observed in full term babies revealed a statistically significant decrease of C_3 complement in the former group ($p < 0.05$).

However, the concentration of C_3 was significantly higher in the IUGR group as compared to that of premature babies ($p < 0.05$).

It was further seen that both the groups of premature babies viz AGA as well as SGA had lesser values of C_3 in comparison to that of IUGR babies. While the values in premature AGA and SGA babies were 32.06±1.45 and 28.5±0.71 mg/100 ml respectively, it was observed that the corresponding C_3 values in IUGR babies was much higher viz. 38.9±1.83 mg/100 ml which was statistically significant ($p < 0.05$).

Serum Complement C_4 Level

The mean serum C_4 in cord blood of IUGR babies was 10.5±2.15 mg/100 ml with a range of 9-15 mg/100 ml.

The mean serum C_4 in the mothers of IUGR babies was 27.8±2.73 mg/100 ml with a range of 22-32 mg/100 ml.

It is evident from these observations that the concentration of C_4 in newborns was 42.4% (10.5±2.15 mg/100 ml) of their mothers (27.8±2.73 mg/100 ml).

Similar to the C_3 values, it was observed that the IUGR babies had also lesser values of serum C_4 (10.5 ±2.79 mg/100 ml) in comparison to the value observed in full term newborns (14.78±2.14 mg/100 ml). Statistical significant difference was also observed between these values.

However, it was observed that IUGR babies had higher values of serum C_4 in comparison to that of premature babies. Values of serum C_4 in IUGR babies and premature babies were 10.5±2.5 and 9.8±1.67 mg/100 ml respectively. However, no statistical different value

was observed between these two groups.

Among premature babies, premature AGA babies as well as premature SGA babies had lower values of serum C_4 in comparison to IUGR babies. However, no statistical significant difference was observed between the two groups ($p > 0.5$).

It can be suggested that this lower value of serum C_3 and C_4 in IUGR babies to that of full term babies is due to their liver immaturity ($p < 0.05$).

COMPLEMENT PROFILE ACCORDING TO BIRTH WEIGHT

At attempt was also made to correlate the complements C_3 and C_4 levels according to birth weight groups in both preterm and term babies irrespective of their gestational age. Accordingly our babies were divided in various birth weight groups viz. 1000-1500, 1500-2000, 2000-2500 and 2500-3000 gms.

Serum Complement C_3 Profile in Full Term Babies according to Their Birth Weight

Full term babies weighing between 1000-1500 gms had lesser values of serum C_3 (35 ± 1 mg/100 ml) as compared to that of babies weighing between 1500-2000 gms, 2000-2500, and 2500-3000 gms, values being 39.9 ± 1.81, 43.90 ± 6.94 and 46.56 ± 5.38 mg/100 ml respectively. A statistical significant value was found in all these groups ($p < 0.05$).

Full term babies weighing between 1500-2000 gms had lesser value of serum C_3 (39.9 ± 1.87 mg/100 ml) in comparison to that of babies weighing between 2000-2500

gms and 2500-3000 gms values being 43.90±6.94 and 46.56± 5.38 mg/100 ml respectively. Difference in the values was found to be statistically significant in all the groups ($p < 0.05$). While full term babies weighing between 2000-2500 gms had lesser value of serum C_3 (43.90±6 mg/100 ml) in comparison to that of babies weighing between 2500-3000 gms (46.56±5.38 mg/100 ml). However, no statistical difference was found between these groups ($p > 0.5$).

SERUM COMPLEMENT C_3 PROFILE IN PREMATURE BABIES ACCORDING TO BIRTH WEIGHT

Among premature babies, babies weighing between 1500-2000 gms had higher value of serum C_3 (32.06±1.45 mg/100 ml) as compared to that of babies weighing between 1000-1500 gms(28.5±0.71 mg/100 ml). The values were found to be statistically significant as determined by student 't' test ($p < 0.05$).

SERUM COMPLEMENT C_4 PROFILE IN FULL TERM BABIES ACCORDING TO BIRTH WEIGHT

Full term babies weighing between 1000-1500 gms had lesser value of serum C_4 as compared to that of babies weighing between 1500-2000 gms, 2000-2500 and 2500-3000 gms values being 9.5±0.5, 12.0±1.80, 14.54±2.18 and 16.9±2.90 mg/100 ml respectively. A statistically significant difference was observed between all these groups ($p < 0.05$).

Babies weighing between 1500-2000 gms had lesser values of serum C_4 (12.0±1.8 mg/100 ml) as compared to that of babies weighing between 2000-2500 and 2500-3000 gms values being 14.54±2.18 and 16.9±2.9 mg/100 ml respectively. A statistically significant difference was observed between babies weighing between 1500-2000 and 2500-3000 gms. However no statistically significant difference was observed between babies weighing between 1500-2000 and 2000-2500 gms.

Babies weighing between 2000-2500 gms had lesser value of serum C_4 (14.54±2.18 mg/100 ml) as compared to that of babies weighing between 2500-3000 gms (16.9±2.9 mg/100 ml). However no statistically significant difference was observed between these groups.

SERUM COMPLEMENT C_4 PROFILE IN PREMATURE BABIES ACCORDING TO BIRTH WEIGHT

Premature babies weighing between 1500-2000 gms, had higher values of serum C_4 (9.9±1.76 mg/100 ml) as compared to that of babies weighing between 1000-1500 gms (9±1 mg/100 ml). Difference was not statistically significant as determined by student 't' test ($p > 0.5$).

A significant finding of present study was that a linear correlation, was observed between the increasing birth weight of babies to the increasing serum level of serum complement C_3 and C_4 levels. Babies having least birth weight had least values of serum complement C_3 and C_4 in both term and preterm babies in comparison to their

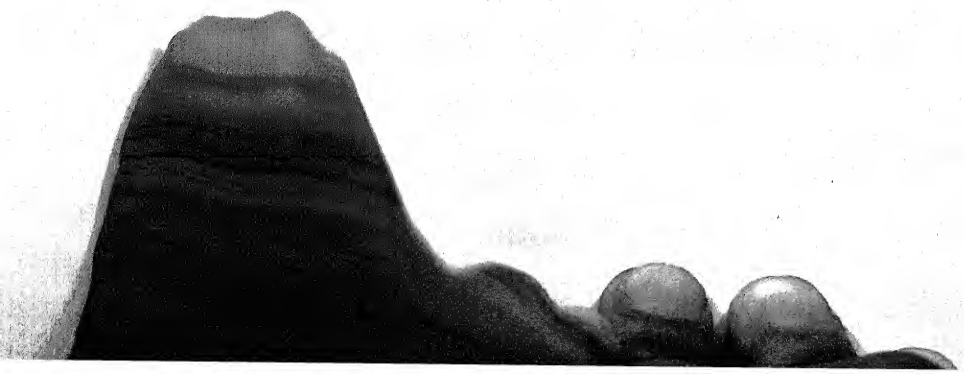
counterpart who had more birth weight.

CONCLUSIONS

Following inferences have been drawn from the present study.

1. Concentration of serum C_3 in full term neonates was 49.1% of their mothers, while premature babies had 32.2% and IUGR babies had 43.2% of serum C_3 in comparison to its value in mothers. Concentration of serum C_4 in full term neonates was 50.1% of their mothers while premature babies had 39.7% and IUGR babies had 42.4% of serum C_4 in comparison of its value in mothers, signifying the time proven fact that complement is not passively transfered from the mothers but is synthesized in the fetus.
2. Premature babies had lesser value of serum C_3 and C_4 in comparison to that of full term and IUGR babies.
3. Premature small for gestational age babies had least value of serum complement C_3 and C_4.
4. A linear correlation was found between increasing birth weight and increasing value of serum complement C_3 and C_4. It was found that babies having lesser birth weight had lesser values of serum complement C_3 and C_4 in comparison to their counterpart having more birth weight.

B I B L I O G R A P H Y



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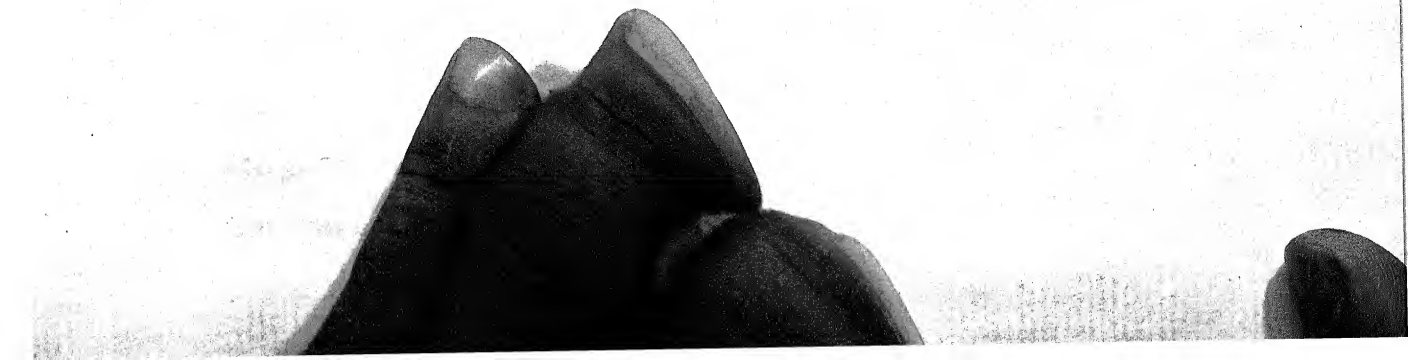

WORKING PROFORMA

A CONCURRENT STUDY OF COMPLEMENT C_3 AND C_4 ACTIVITY IN MATERNAL AND NEONATAL SERUM

Case No. _____

MRD No. _____ Date :

Patient's Name : Ward/Bed:

Age :

Baby Name : Age/Sex:

Socio-economic status:

BRIEF OBSTETRICAL HISTORY OF MOTHER

Gravida/Parity/Abortion

ANTENATAL HISTORY

- H/o high grade fever associated with rash
- H/o any painful glandular enlargement.
- H/o APH.
- H/o leaking (Duration)/ colour/odour)
- H/o ABO, Rh incompatibility

NATAL HISTORY

- Presentation
- Mode of delivery | Vaginal/Forcep/Caesarean.

POST NATAL HISTORY

- APGAR Score at 1 min. 5 min.
- Cry immediately after birth : Present/Absent
- Congenital anomalies :
- Any resuscitation used/not used:

EXAMINATIONS

GENERAL EXAMINATION OF MOTHER

Anaemia
Oedema
Convulsion
B.P.
Weight
Icterus
Cyanosis
Clubbing
Gen. lymphadenopathy

SYSTEMIC EXAMINATION OF MOTHER

Cardiovascular System

Respiratory System

Central Nervous System

Abdominal Examination

EXAMINATION OF NEWBORN

Colour :

Heart rate :

Resp. rate :

Response to stimulus :

Posture :

GESTATIONAL AGE (WEEKS)

By L.M.P. :

By fundal height :

By morphological examination :

ANTHROPOMETRIC EXAMINATION

Weight : Head circumference :

Length : Chest circumference:

MORPHOLOGICAL CRITERIA

Criteria	Score : 0	1	2	3
a. Sking texture Test by inspection and pinching	Very thin and geletinous	Smooth, medium thickness with superficial peeling	Thick with peeling and cracking over hands and feet.	
b. Lanugo examine on the back	Nill or scanty	Abundant lanugo	Thinning lanugo at places	
c. Plantar creases Assess after stretching the skin.	Nil	Faint red marks over ant. half of sole.	Deep indentation over ant.1/3 to 1/2 of sole.	Deep indentation throughout the sole
d. Breast nodule Test by holding the breast tissue between thumb and finger.	Nil	Breast tissue ⩽5 mm on one or both sides.	Breast tissue 5-10 mm	Breast tissue ⩾10 mm
e. Ear firmness Assess by palpation	Pinna feels soft and easily folded in Bizarre shopes. No recoil.	Soft but some Recoil is present	Some cartilage felt along the edge and recoil is instant.	Pinna firm with definite cartilage throughout and instant recoil.
f. Genitalia - Male	Neither testes in scrotum	Atleast one testes high in scrotum.	Atleast one testes down in scrotum.	
- Female	Labia majora widely separated labia minora protruding.	Labia majora almost cover labia minora	Labia majora completely cover labia minora.	

Score : 0 - 16

28 29 30 31 32 34 37

9 10 11 12 13 14 16